

1 39. The combination of claim 21 including a
2 fuel cell in operating communication with said reaction
3 chamber, to receive hydrogen therefrom.

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6 40. The method of converting a hydrocarbon
7 to industrial gases, that includes:

8 a) providing a U-shaped flow through
9 tubular reaction chamber disposed upright within a
10 combustion chamber, and a catalyst contained within
11 said reaction chamber for the conversion of said
12 hydrocarbon to said industrial gases by reaction with
13 steam; said reaction chamber having an upper portion,
14 and there being a convection chamber extending about
15 said upper portion to enhance the transfer of heat from
16 combustion products in the reaction chamber,

17 b) providing a radiant burner generally
18 vertically disposed within the combustion chamber and
19 having a gas permeable zone that promotes the flameless
20 combustion of fuel and oxidant supplied to said burner
21 in order to heat a fiber surface of the burner to
22 incandescence for radiating heat to the reaction
23 chamber; said radiant burner configured so that the
24 angle of radiation is predominantly incident upon the
25 surface of the tubular reaction chamber,

1 c) supplying said hydrocarbon and steam to
2 the reaction chamber heated by said radiant burner,
3 d) and removing said industrial gases
4 including hydrogen from the reaction chamber.

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7 41. The method of claim 40 including
8 providing a gas conditioning system and fuel cell, and
9 supplying said hydrogen to said fuel cell.

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12 42. The method of claim 40 wherein said
13 fiber surface of the burner consists of at least one of
14 the following:

15 a) ceramic

16 b) metal.

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1 43. Endothermic catalytic reaction apparatus
2 that includes a combustion chamber, comprising:
3 a) a straight tubular outer conduit
4 concentrically disposed around an inner conduit to form
5 a reaction chamber containing catalyst in the annular
6 space between the outer conduit wall and the inner
7 conduit wall, for conversion of hydrocarbon to
8 industrial gases by reaction with steam, and an inner
9 conduit defined space for the return flow of reactant
10 gases to an exit means; said tubular reaction chamber
11 having one end that extends into the combustion chamber
12 and an opposite end that extends outside of the
13 combustion chamber, and there being inlet means that is
14 in communication with the annular space and an exit
15 means that is in communication with the inner conduit
16 defined space,
17 b) and a radiant burner vertically disposed
18 within said combustion chamber and having a gas
19 permeable zone that promotes the flameless combustion
20 of fuel and oxidant supplied to said burner in order to
21 heat the metal fiber surface of the burner to
22 incandescence for radiating heat energy to the reaction
23 chamber.
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